Division of Water
Indiana Department of Natural Resources
Hydraulic Modeling Checklist

This checklist will assist the staff at the Division of Water in the review of modeling for the definition of the floodway, for evaluation of a Construction in a Floodway permit application, for state concurrence of a Letter of Map Revision or a Flood Insurance Study or any other modeling that is submitted for review. The checklist items are based on the document "General Guidelines for the Hydrologic-Hydraulic Assessment of Floodplains in Indiana." The modeler should be familiar with this document and any discrepancies between the general guidelines and the submitted modeling should be discussed with the Division of Water Engineering Services staff prior to submittal.

This completed checklist must be submitted to the Division of Water along with your models. The Division of Water <u>will not</u> review any modeling submittal that is not accompanied by a completed checklist.

Please keep in mind that these questions were written primarily for the application of HEC-RAS computer models. HEC-RAS is preferred by the Division of Water, however, other modeling programs may be used provided their use has been discussed previously with Division of Water Staff. Should you have any questions, please contact Division of Water staff at (317) 232–4160 or toll free at (877) 928-3755.

1. General Information

a. Preparer Name: _____
(Name of individual who prepared the submitted modeling)

b. Preparer Firm: _____

c. Date: _____

2. Project Location and Background Information

a. Waterbody Name: _____
_____
(Use name as shown on USGS 7 ½ minute quadrangle)

b. Location Description: _____
_____
(Example: Along the west bank of Blank Creek beginning at Culvert Avenue and extending upstream (north) approximately 2,000 feet to C.R. 700 North)

c. Nearest Town/City: _____

d. County: _____

e. Downstream End of Project Location:

Section: _____ Township: _____ Range: _____ Quadrangle: _____
(if the project is in a grant, reserve or donation, check here and give information below) ☐
_____

Waterbody Name: _____
Preparer: _____
Date: _____

Upstream End of Project Location:

Section: _____ Township: _____ Range: _____ Quadrangle: _____
(if the project is in a grant, reserve or donation, check here and give information below) ☐

_____

f. Study Reach Location: Downstream Limit _____ _____ *(unit of distance)*

Upstream Limit _____ _____ *(unit of distance)*

(Limits should be measured in miles from the mouth of the stream or use units of distance consistent with published flood study. The Division of Water has mileage on many streams.)

g. Type of Model

☐ HEC-RAS ☐ HEC-2 ☐ WSPRO ☐ WSP2 ☐ HY-8

Other _____

h. Published Flood Insurance model *(Name, Study Reach and Date)* _____

i. IDNR model *(Name, Study Reach and Date)* _____

j. Previous FARA / Floodway Permits within study reach *(Application Number and Approval Date)*

1. _____
2. _____
3. _____
4. _____
5. _____

3. Request Information

Please indicate for what purpose the models are submitted for review and approval:

☐ Floodway / Base Flood Elevation Determination (FARA)
☐ Construction in a Floodway Application
☐ Letter of Map Revision (LOMR)
☐ Flood Insurance Study modeling
☐ Other (please describe) _____

_____

Waterbody Name: _____
Preparer: _____
Date: _____

4. Discharges

The source of the 100-year frequency flood discharges used in a hydraulic model need to be fully documented by completing the questions listed below.

It is strongly suggested that a preparer-determined 100-year discharge be submitted for approval prior to the submittal of hydraulic models. Discharge determinations and hydraulic models are considered to be separate items, each subject to review.

a. What is the source of the discharges used in the submitted model *(Please check one):*

- ☐ Discharges based on a curve published in "Coordinated Discharges of Selected Streams in Indiana"
  (Please attach copy of applicable graph)
- ☐ Discharges based on a determination from the Department of Natural Resources
  (Please attach copy of letter from IDNR)
- ☐ Discharges based on hydrologic analyses submitted with this model
  (Please attach a copy of the IDNR approval letter)
- ☐ Discharges from a Flood Insurance Study
- ☐ Discharges from other modeling *(Indicate source)* _____

b. Table of Discharges used in the model *(Expand table as needed)*

Drainage Area (sq. mi.)	Discharge (cfs)	Cross-Section / Location Where Discharge is Specified

c. Comments regarding discharge determination:

_____
_____
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Waterbody Name: _____
Preparer: _____
Date: _____

5. Starting Elevation / Boundary Conditions

Complete the following section fully to document the starting elevations and boundary conditions for starting the model:

a. Boundary condition used to derive starting elevations: *(Please check one)*

- ☐ Known water surface *(Indicate source):* _____
- ☐ Energy slope estimated from historic flood profile *(Indicate date):* _____
- ☐ Energy slope estimated from stream thalweg *(Indicate mapping used):* _____
- ☐ Other *(Please Describe):* _____

b. Description (show any calculations):

_____
_____

6. Manning's Roughness Coefficients ("n" Values)

Complete the following section fully to document the Manning's roughness coefficients:

a. How were the roughness coefficients estimated? *(Check all that apply)*

- ☐ Flood Insurance Study
- ☐ Other modeling
- ☐ Field inspection
- ☐ Site photos
- ☐ Aerial photography or mapping
- ☐ Calibration
- ☐ Other *(Describe)* _____

b. What is the range of the roughness coefficients?

Left Overbank	Minimum _____	Maximum _____
Channel	Minimum _____	Maximum _____
Right Overbank	Minimum _____	Maximum _____

c. Are proposed roughness coefficients different from the base roughness coefficients?

☐ Yes ☐ No

Note: In most cases, the Department will not approve modeling based on an "improved" condition. If the "Yes" box is checked, you will need to justify the use of the modified roughness coefficients below. It is strongly suggested that these issues should be discussed with personnel at the Department prior to submittal.

Waterbody Name: _____
Preparer: _____
Date: _____

d. Description of "n" values

Please further describe the methods checked above that were used to estimate the roughness coefficients. If they are estimated from photos, please attach copies of the photos, along with an orientation map. If the roughness coefficients are estimated by calibration, please submit supporting documentation.

e. Check-RAS

For HEC-RAS models, please run the "NT" report from Check-RAS and attach it to this checklist. List any comments in the model and justification for not correcting these comments (use additional sheets, if necessary):

Waterbody Name: _____
Preparer: _____
Date: _____

7. Cross Sections

The following questions have to do with the cross section information that is the basis of the submitted modeling:

a. What is the source of the cross section information *(check all that apply):*
- ☐ Flood Insurance Study
- ☐ Field survey *(Date)* _____
- ☐ Detailed topographic mapping *(Date)* _____
- ☐ Other modeling *(Indicate source)* _____
- ☐ Other *(please specify)* _____
  _____

b. Are cross sections stationed increasing from left to right looking downstream?
☐ Yes ☐ No

c. How are sections labeled *(check one)* (Note: The following list is in order of preference)
- ☐ Consistent with FIS / other studies
- ☐ Miles above mouth
- ☐ Feet above other landmark *(Please specify landmark)* _____
- ☐ Other *(Please specify)* _____

d. Are sections oriented perpendicular to flow at all portions of the cross section?
☐ Yes ☐ No

e. Are the full cross section extents shown on submitted mapping?
☐ Yes ☐ No

f. Do the cross sections extend fully across the floodplain *(above expected 100-year flood elevations)*?
☐ Yes ☐ No

g. Do the cross sections represent average conditions in the reach at which they are located?
☐ Yes ☐ No

h. Are areas of blocked or ineffective flow indicated on the submitted cross sections?
☐ Yes ☐ No

i. Are cross sections located at places where discharge values change along the stream reach?
☐ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

j. For any "No" answers above, please provide an explanation:

_____
_____
_____
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_____

k. Are interpolated sections used anywhere in the model (if yes, state reasons for using interpolated sections)

☐ Yes ☐ No

Reason: _____
_____
_____
_____

l. Check-RAS

For HEC-RAS models, please run the "XS" report from Check-RAS and attach it to this checklist. List any comments in the model and justification for not correcting these comments (use additional sheets, if necessary):

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Waterbody Name: _____
Preparer: _____
Date: _____

8. Bridges

The following questions should be answered for each bridge in the model being submitted. Use a separate sheet for each bridge

a. Name of Bridge in model: _____

b. Bridge cross-section locations *(See Section 8.9 of the Guidelines for location of bridge sections):*

Section 1 Cross-section number: _____
Section 2 Cross-section number: _____
Section 3 Cross-section number: _____
Section 4 Cross-section number: _____

c. Is this model submitted in support of a Construction in a Floodway application for the bridge in question?

☐ Yes ☐ No

d. If the answer to c is "yes," then are the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?

☐ Yes ☐ No ☐ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?

☐ Yes ☐ No

f. Is cross section 1 located at a 2:1 flow expansion ratio downstream of the bridge face?

☐ Yes ☐ No

g. Is cross section 4 located at a 1:1 flow contraction ratio upstream of the bridge face?

☐ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the bridge?

☐ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?

☐ Yes ☐ No

j. What is the selected modeling method *(for the 100-year frequency flood only)*

☐ Energy (Low flow)
☐ Momentum (Low flow)
☐ WSPRO (Low flow)
☐ Energy (High flow)
☐ Pressure / Weir flow (High flow)

k. Does approach roadway profile data extend across the full valley cross section?

☐ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

l. Are bridge piers included in the model?
☐ Yes ☐ No

m. Were HEC-RAS default embankment side slopes applied at all bridge crossings in the model?
☐ Yes ☐ No

n. For all "No" answer above, please provide an explanation:

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o. Check-RAS

For HEC-RAS models, please run the "Structure" report from Check-RAS and attach it to this checklist. List any comments in the model and justification for not correcting these comments (use additional sheets, if necessary):

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Waterbody Name: _____
Preparer: _____
Date: _____

9. Culverts

The following questions should be answered for each culvert in the model being submitted. Use a separate sheet for each culvert:

a. Name of Culvert in model: _____

b. Cross section locations (See Section 8.9 and 8.10 of the Guidelines for the location of culvert sections):

Section 1 Cross section number: _____
Section 2 Cross section number: _____
Section 3 Cross section number: _____
Section 4 Cross section number: _____

c. Is this model submitted in support of a Construction in a Floodway application for the culvert in question?

☐ Yes ☐ No

d. If the answer to c is "yes," then is the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?

☐ Yes ☐ No ☐ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?

☐ Yes ☐ No

f. Is cross-section 1 located at a 2:1 flow expansion ratio downstream of the culvert?

☐ Yes ☐ No

g. Is cross-section 4 located at a 1:1 flow contraction ratio upstream of the culvert?

☐ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the culvert?

☐ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?

☐ Yes ☐ No

j. Does approach roadway profile data extend across the full valley cross section?

☐ Yes ☐ No

k. Were HEC-RAS default embankment side slopes applied at all culvert crossings in the model?

☐ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

l. For all "No" answer above, please provide an explanation:

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m. Check-RAS

For HEC-RAS models, please run the "Structure" report from Check-RAS and attach it to this checklist. List any comments in the model and justification for not correcting these comments (use additional sheets, if necessary):

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Waterbody Name: _____
Preparer: _____
Date: _____

10. Floodways

Has floodway determination been done in accordance with Section 8.12 of the Guidelines?

☐ Yes ☐ No ☐ N/A

11. Model Output

For all model outputs review the "errors and warnings" and address those comments not already addressed.

_____
_____
_____
_____
_____
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12. Documentation

Submitted documentation *(Check all that apply)*:

- ☐ Narrative regarding modeling
- ☐ Application Forms and/or LOMR Application Forms
- ☐ Pictures of stream reach *(w/ orientation map)*
- ☐ FIS map / profile
- ☐ Previous FARA/Floodway permits in study reach *(Including maps)*
- ☐ Check-RAS output
- ☐ Cross Section plots
- ☐ HEC-RAS "Standard Table 1"
- ☐ HEC-RAS "Encroachment 1" table *(Show where the 0.14' surcharge occurs)*
- ☐ Profile plots
- ☐ Summary of Modeling and Project Evaluation Results *(Mandatory – See Figure 3.1)*
- ☐ Floodplain mapping including:
    - ☐ Stream in question *(Along with other hydrographic features)*
    - ☐ Roads *(With street names)*
    - ☐ Existing features *(Buildings, parking lots, woods, etc)*

Waterbody Name: _____
Preparer: _____
Date: _____

- ☐ The full extent of each cross section included in the model, with each cross section clearly labeled *(Include the location of initial and end points as used in the model)*
- ☐ Contour topographic data *(If available)*
- ☐ Property limits *(Approximate property limits are acceptable only if surcharges are 0.14' or less at all cross sections)*
- ☐ North arrow
- ☐ Scale *(Numerical and graphical)*
- ☐ Horizontal and vertical control benchmark used *(See Section 5.4 of the Guidelines for benchmark guidance.)*
- ☐ Horizontal and vertical datums
- ☐ Delineated flood fringe and floodway limits

  (The flood fringe and floodway should be shaded so that it is obvious to the reviewer what areas are flood fringe and floodway, but not shaded so dark that other features are obscured. For multi-colored plans, the Division of Water convention is to shade the flood fringe blue and the floodway yellow. See Section 8.12 of the Guidelines for delineation guidance.)

- ☐ Disk with input data and model output *(Check all that apply)*
  - ☐ Base Condition (FIS, IDNR Regulatory) File name: _____
  - ☐ Duplicate Effective File name: _____
  - ☐ Corrected Effective File name: _____
  - ☐ Existing (Pre-project) File name: _____
  - ☐ Proposed (Post-project) File name: _____

Waterbody Name: _____
Preparer: _____
Date: _____

13. Affirmation

By signing this document you are indicating that the submitted models have been developed and reviewed in accordance with accepted Division of Water procedures, that should the Division of Water find inconsistencies between your submitted models and the checklist, you will be notified in writing of the deficiencies and given 90 days to correct these problems; and that if after 90 days these inconsistencies still exist, you will be notified that your model is unacceptable and the Department will take no further action if the request is for a FARA, or issue a denial notice if the request is associated with a permit application.

_____
Date:

_____
Signature

_____
Name

_____
Firm

Division of Water Use Only

Date Received _____ File Number _____

Reviewer _____ Date reviewed _____

☐ Approved ☐ Rejected

Section Manager Review _____